## CLAIMS

**1.** A method of making a magnetic read head which has an air bearing surface (ABS), comprising the steps of:

a making a spin valve sensor comprising the steps of:

forming a ferromagnetic first pinned layer structure that has a magnetic moment;

forming an antiferromagnetic first pinning layer exchange coupled to the first pinned layer structure for pinning the magnetic moment of the first pinned layer structure;

forming a ferromagnetic free layer structure;

forming a nonmagnetic electrically conductive first spacer layer between the free layer structure and the first pinned layer structure; and

forming the first pinned layer structure by sputter deposition of cobalt (Co) or a cobalt based alloy in a nitrogen ($N_2$) atmosphere.

**2.** A method as claimed in claim 1 including the steps of:

forming nonmagnetic electrically nonconductive first and second read gap layers;

forming the spin valve sensor between the first and second read gap layers;

forming ferromagnetic first and second shield layers; and

forming the first and second read gap layers between the first and second shield layers.

**3.** A method as claimed in claim 2 wherein the cobalt based alloy is cobalt iron (CoFe).

**4.** A method as claimed in claim 3 wherein the sputter deposition is ion beam sputtering with a nitrogen partial pressure of $2 \times 10^{-5}$ Torr.

5. A method as claimed in claim 2 including the steps of

forming a ferromagnetic second pinned layer structure and a nonmagnetic second spacer layer with the free layer structure located between the first and second spacer layers and the first and second spacer layers located between the first and second pinned layer structures.

6. A method as claimed in claim 5 wherein each of the first and second pinned layer structure is an antiparallel (AP) pinned layer structure that is made comprising the steps of:

forming ferromagnetic first and second antiparallel (AP) pinned layers with the first AP pinned layer interfacing the pinning layer and the second AP pinned layer interfacing the spacer layer;

forming an antiparallel (AP) coupling layer between and interfacing the first and second AP pinned layers; and

forming the second AP pinned layer of the first pinned layer structure by said sputter deposition of cobalt iron (CoFe) in a nitrogen ($N_2$) atmosphere.

7. A method as claimed in claim 6 including the steps of:

each of the first and second spacer layers being formed of copper (Cu) with a thickness from 19Å and 23Å; and

forming the spin valve sensor with a ferromagnetic coupling field ($H_F$) from 0 Oe to –10 Oe.

8. A method as claimed in claim 7 wherein the sputter deposition is ion beam sputtering with a nitrogen partial pressure of $2 \times 10^{-5}$ Torr.

9. A method of making magnetic head assembly that has an air bearing surface (ABS), comprising the steps of:

making a write head including the steps of:

forming ferromagnetic first and second pole piece layers in pole tip, yoke and back gap regions wherein the yoke region is located between the pole tip and back gap regions;

forming a nonmagnetic electrically nonconductive write gap layer between the first and second pole piece layers in the pole tip region;

forming an insulation stack with at least one coil layer embedded therein between the first and second pole piece layers in the yoke region; and

connecting the first and second pole piece layers at said back gap region;

making a read head including the steps of:

forming nonmagnetic electrically nonconductive first and second read gap layers;

forming a spin valve sensor between the first and second read gap layers; and

forming the first and second read gap layers between the first shield layer and the first pole piece layer;

a making of the spin valve sensor comprising the steps of:

forming a ferromagnetic first pinned layer structure that has a magnetic moment;

forming an antiferromagnetic first pinning layer exchange coupled to the first pinned layer structure for pinning the magnetic moment of the first pinned layer structure;

forming a ferromagnetic free layer structure;

forming a nonmagnetic electrically conductive first spacer layer between the free layer structure and the first pinned layer structure; and

forming the first pinned layer structure by sputter deposition of cobalt (Co) or a cobalt based alloy in a nitrogen ($N_2$) atmosphere.

**10.** A method as claimed in claim 9 wherein the cobalt based alloy is cobalt iron (CoFe).

**11.** A method as claimed in claim 10 wherein the sputter deposition is ion beam sputtering with a nitrogen partial pressure of $2 \times 10^{-5}$ Torr.

**12.** A method as claimed in claim 9 including the steps of:

forming a ferromagnetic second pinned layer structure and a nonmagnetic second spacer layer with the free layer structure located between the first and second spacer layers and the first and second spacer layers located between the first and second pinned layer structures.

**13.** A method as claimed in claim 12 wherein each of the first and second pinned layer structure is an antiparallel (AP) pinned layer structure that is made comprising the steps of:

forming ferromagnetic first and second antiparallel (AP) pinned layers with the first AP pinned layer interfacing the pinning layer and the second AP pinned layer interfacing the spacer layer;

forming an antiparallel (AP) coupling layer between and interfacing the first and second AP pinned layers; and

forming the second AP pinned layer of the first pinned layer structure by said sputter deposition of cobalt iron (CoFe) in a nitrogen ($N_2$) atmosphere.

**14.** A method as claimed in claim 13 including the steps of:

each of the first and second spacer layers being formed of copper (Cu) with a thickness from 19Å and 23Å; and

forming the spin valve sensor with a ferromagnetic coupling field ($H_F$) from 0 Oe to –10 Oe.

**15.** A method as claimed in claim 14 wherein the sputter deposition is ion beam sputtering with a nitrogen partial pressure of $2 \times 10^{-5}$ Torr.

**16.** A magnetic read head which has an air bearing surface (ABS), comprising:

a spin valve sensor including:

a ferromagnetic first pinned layer structure that has a magnetic moment;

an antiferromagnetic first pinning layer exchange coupled to the first pinned layer structure for pinning the magnetic moment of the first pinned layer structure;

a ferromagnetic free layer structure;

a nonmagnetic electrically conductive first spacer layer located between the free layer structure and the first pinned layer structure; and

the first pinned layer structure having been formed by sputter deposition of cobalt (Co) or a cobalt based alloy in a nitrogen ($N_2$) atmosphere.

**17.** A magnetic read head as claimed in claim 16 including:

nonmagnetic electrically nonconductive first and second read gap layers;

the spin valve sensor being located between the first and second read gap layers;

ferromagnetic first and second shield layers; and

the first and second read gap layers being located between the first and second shield layers.

**18.** A magnetic read head as claimed in claim 17 wherein the cobalt based alloy is cobalt iron (CoFe).

**19.** A magnetic read head as claimed in claim 18 wherein the sputter deposition is ion beam sputtering with a nitrogen partial pressure of $2 \times 10^{-5}$ Torr.

**20.** A magnetic read head as claimed in claim 17 including:

a ferromagnetic second pinned layer structure and a nonmagnetic second spacer layer;

the free layer structure being located between the first and second spacer layers and the first and second spacer layers being located between the first and second pinned layer structures.

**21.** A magnetic read head as claimed in claim 20 wherein each of the first and second pinned layer structures is an antiparallel (AP) pinned layer structure that comprises:

ferromagnetic first and second antiparallel (AP) pinned layers with the first AP pinned layer interfacing the pinning layer and the second AP pinned layer interfacing the spacer layer;

an antiparallel (AP) coupling layer located between and interfacing the first and second AP pinned layers; and

the second AP pinned layer of the first pinned layer structure having been formed by said sputter depositon of cobalt iron (CoFe) in a nitrogen ($N_2$) atmosphere.

**22.** A magnetic read head as claimed in claim 21 including:

each of the first and second spacer layers being composed of copper (Cu) and having a thickness from 19Å and 23Å; and

the spin valve sensor having a ferromagnetic coupling field ($H_F$) from 0 Oe to –10 Oe.

**23.** A magnetic read head as claimed in claim 22 wherein the sputter deposition is ion beam sputtering with a nitrogen partial pressure of $2 \times 10^{-5}$ Torr.

**24.** A magnetic head assembly having an air bearing surface (ABS), comprising:

a write head including:

ferromagnetic first and second pole piece layers that have a yoke portion located between a pole tip portion and a back gap portion;

a nonmagnetic write gap layer located between the pole tip portions of the first and second pole piece layers;

an insulation stack with at least one coil layer embedded therein located between the yoke portions of the first and second pole piece layers; and

the first and second pole piece layers being connected at their back gap portions; and

a read head including:

a spin valve sensor;

nonmagnetic electrically nonconductive first and second read gap layers;

the spin valve sensor being located between the first and second read gap layers;

a ferromagnetic first shield layer; and

the first and second gap layers being located between the first shield layer and the first pole piece layer; and

the spin valve sensor including:

a ferromagnetic first pinned layer structure that has a magnetic moment;

an antiferromagnetic first pinning layer exchange coupled to the first pinned layer structure for pinning the magnetic moment of the first pinned layer structure;

a ferromagnetic free layer structure;

a nonmagnetic electrically conductive first spacer layer located between the free layer structure and the first pinned layer structure; and

the first pinned layer structure having been formed by sputter deposition of cobalt (Co) or a cobalt based alloy in a nitrogen ($N_2$) atmosphere.

**25.** A magnetic head assembly as claimed in claim 24 wherein the cobalt based alloy is cobalt iron (CoFe).

**26.** A magnetic head assembly as claimed in claim 25 wherein the sputter deposition is ion beam sputtering with a nitrogen partial pressure of $2 \times 10^{-5}$ Torr.

**27.** A magnetic head assembly as claimed in claim 24 including:

a ferromagnetic second pinned layer structure and a nonmagnetic second spacer layer;

the free layer structure being located between the first and second spacer layers and the first and second spacer layers being located between the first and second pinned layer structures.

**28.** A magnetic head assembly as claimed in claim 27 wherein each of the first and second pinned layer structures is an antiparallel (AP) pinned layer structure that comprises:

ferromagnetic first and second antiparallel (AP) pinned layers with the first AP pinned layer interfacing the pinning layer and the second AP pinned layer interfacing the spacer layer;

an antiparallel (AP) coupling layer located between and interfacing the first and second AP pinned layers; and

the second AP pinned layer of the first pinned layer structure having been formed by said sputter depositon of cobalt iron (CoFe) in a nitrogen ($N_2$) atmosphere.

**29.** A magnetic head assembly as claimed in claim 28 including:

each of the first and second spacer layers being composed of copper (Cu) and having a thickness from 19Å and 23Å; and

the spin valve sensor having a ferromagnetic coupling field ($H_F$) from 0 Oe to –10 Oe.

**30.** A magnetic head assembly as claimed in claim 29 wherein the sputter deposition is ion beam sputtering with a nitrogen partial pressure of $2 \times 10^{-5}$ Torr.

**31.** A magnetic disk drive including at least one magnetic head assembly that has an air bearing surface (ABS) and that includes a write head and a read head, comprising:

a write head including:

ferromagnetic first and second pole piece layers that have a yoke portion located between a pole tip portion and a back gap portion;

a nonmagnetic write gap layer located between the pole tip portions of the first and second pole piece layers;

an insulation stack with at least one coil layer embedded therein located between the yoke portions of the first and second pole piece layers; and

the first and second pole piece layers being connected at their back gap portions; and

a read head including:

a spin valve sensor;

nonmagnetic electrically nonconductive first and second read gap layers;

the spin valve sensor being located between the first and second read gap layers;

a ferromagnetic first shield layer; and

the first and second read gap layers being located between the first shield layer and the first pole piece layer; and

the spin valve sensor including:

a ferromagnetic first pinned layer structure that has a magnetic moment;

an antiferromagnetic first pinning layer exchange coupled to the first pinned layer structure for pinning the magnetic moment of the first pinned layer structure;

a ferromagnetic free layer structure;

a nonmagnetic electrically conductive first spacer layer located between the free layer structure and the first pinned layer structure; and

the first pinned layer structure having been formed by sputter deposition of cobalt (Co) or a cobalt based alloy in a nitrogen ($N_2$) atmosphere;

a housing;

a magnetic disk rotatably supported in the housing;

a support mounted in the housing for supporting the magnetic head assembly with said ABS facing the magnetic disk so that the magnetic head assembly is in a transducing relationship with the magnetic disk;

a spindle motor for rotating the magnetic disk;

an actuator positioning means connected to the support for moving the magnetic head assembly to multiple positions with respect to said magnetic disk; and

a processor connected to the magnetic head assembly, to the spindle motor and to the actuator for exchanging signals with the magnetic head assembly, for controlling movement of the magnetic disk and for controlling the position of the magnetic head assembly.

**32.** A magnetic disk drive as claimed in claim 31 wherein the cobalt based alloy is cobalt iron (CoFe).

**33.** A magnetic disk drive as claimed in claim 32 wherein the sputter deposition is ion beam sputtering with a nitrogen partial pressure of $2 \times 10^{-5}$ Torr.

**34.** A magnetic disk drive as claimed in claim 31 including:

a ferromagnetic second pinned layer structure and a nonmagnetic second spacer layer;

the free layer structure being located between the first and second spacer layers and the first and second spacer layers being located between the first and second pinned layer structures.

**35.** A magnetic disk drive as claimed in claim 34 wherein each of the first and second pinned layer structures is an antiparallel (AP) pinned layer structure that comprises:

ferromagnetic first and second antiparallel (AP) pinned layers with the first AP pinned layer interfacing the pinning layer and the second AP pinned layer interfacing the spacer layer;

an antiparallel (AP) coupling layer located between and interfacing the first and second AP pinned layers; and

the second AP pinned layer of the first pinned layer structure having been formed by said sputter depositon of cobalt iron (CoFe) in a nitrogen ($N_2$) atmosphere.

**36.** A magnetic disk drive as claimed in claim 35 including:

each of the first and second spacer layers being composed of copper (Cu) and having a thickness from 19Å and 23Å; and

the spin valve sensor having a ferromagnetic coupling field ($H_F$) from 0 Oe to –10 Oe.

**37.** A magnetic disk drive as claimed in claim 36 wherein the sputter deposition is ion beam sputtering with a nitrogen partial pressure of $2 \times 10^{-5}$ Torr.